

Ground-Water Characterization, Monitoring, and Evaluation for Coalbed Methane Development

Powder River Basin Controlled Groundwater Area

Introduction

The purpose of this guidance document is to assist coal bed methane (CBM) operators in preparing ground water monitoring and evaluation plans for prospective CBM fields in the Powder River Basin Controlled Groundwater Area (PRBCGA). Ground water monitoring and evaluation plans are components of field development plans that must be submitted with applications to the Montana Board of Oil and Gas Conservation (MBOGC) to establish permanent spacing and field rules. In addition, ground-water monitoring and evaluation plans must be submitted for review to the Technical Advisory Committee (TAC) for the PRBCGA prior to submission to MBOGC.

Background

The Montana Department of Natural Resources and Conservation (DNRC) created the PRBCGA (Figure 1) on December 15, 1999 to protect existing water users from potential impacts of CBM development. The PRBCGA was created because groundwater withdrawals from CBM wells are likely to occur in the near future causing water levels in coal bed aquifers to be reduced within and near CBM project areas for long periods of time. Declines of water levels in wells and flows in springs or streams are of particular concern because such declines could adversely affect existing water users in the Powder River Basin.

The Montana Board of Oil and Gas Conservation (MBOGC), through its Order No. 99-99, requires CBM producers in the PRBCGA to evaluate pre-development ground-water conditions, and submit monitoring and evaluation plans that include procedures for monitoring and reporting the effects of CBM development on water users (see Table 1 for recommended elements of ground-water monitoring and evaluation plans). The TAC, administered by the DNRC Water Resources Division, makes recommendations to the MBOGC regarding contents of ground-water monitoring and evaluation plans.

Pre-Development Characterization

The purpose of pre-development characterization is to identify water users and evaluate pre-development conditions. Pre-development characterization includes a well and spring inventory, and descriptions of coal bed hydrogeology and pre-development ground water conditions. Information collected during pre-development characterization forms the basis for evaluating reduction or loss of water resources as a result of CBM development.

Well and Spring Inventory

The purpose of a well and spring inventory is to identify water users that might be affected by ground-water pumping during CBM development and to collect basic data on well or spring characteristics listed in Table 1. All wells and springs within a proposed CBM field and a minimum of three miles outside its boundary should be identified from MBMG and DNRC records, and through interviews with local landowners.

Coal Bed Hydrogeology

Information on the stratigraphy and structure of coal beds targeted for CBM, and measurements of hydraulic properties of coal zones are necessary to predict potential effects of CBM production. Locations where target coal beds crop out or form subcrops beneath alluvium should be identified and the potential that pressure reductions resulting from CBM production could impact springs or groundwater discharge should be evaluated.

Pre-Development Ground-Water Conditions

Ground-water conditions in coal beds targeted for CBM development and related sandstone aquifers need to be monitored and compared to production ground-water conditions to determine impacts. Water level elevations and spring flows should be monitored for a minimum of one year before production begins to characterize seasonal fluctuations and to map the pre-development potentiometric surface(s) of target coal bed aquifer(s) or related sandstone aquifer(s).

Water Source Mitigation Agreements

Water source mitigation agreements are intended to address reduction or loss of water resources as a result of CBM development. Procedures for evaluating and mitigating impacts to wells or springs should be described. Well logs, hydrographs of water levels in wells, spring flows, chemical analyses of water samples, and potentiometric surface maps may be useful for operators to evaluate potential impacts to water users.

Monitoring and Evaluation Plans

The purpose of monitoring and evaluation plans is to describe the types and sources of data to be used to evaluate any reduction or loss of water resources as a result of CBM development. Monitoring and Evaluation plans need to include descriptions of production ground water conditions, and reporting and evaluation procedures.

Production Ground-Water Conditions

The purpose of production ground-water monitoring is to detect changes in ground-water levels or yields and spring flows resulting from CBM development. Procedures for monitoring volumes of groundwater pumped from CBM wells and ground-water elevations or pressures should be described in the ground-water monitoring and evaluation plan. Wells or springs that will be used to determine water elevations or pressures should be specified in the plan. Monitoring should be expanded outward if significant, or unexpectedly large drawdown occurs at the most distant monitored wells.

Reporting and Evaluation

Annual monitoring and evaluation reports need to be submitted to the MBOGC and the TAC, summarizing work completed, and groundwater data collected, obtained, and compiled from the previous calendar year. A map showing locations of wells and springs inventoried for a project along with source information listed in Table 1, and locations of CBM production wells is an essential element of an annual monitoring report. Updated structural geologic maps and cross-sections, potentiometric and drawdown maps, and a summary of production volumes and any other data listed in Table 1 should be provided for all coalbeds being developed for CBM. Narratives of annual monitoring and evaluation reports need to address progress of CBM development, changes in ground-water conditions, and impacts to water users. Methods used to collect and analyze data, and any modifications to the monitoring and evaluation plan need to be described.

Table 1. Recommended elements of ground water monitoring and evaluation plans.

Element	Types of Data	Sources of Data	Presentation of Data
Well and Spring Inventory	Location and elevation Depth, construction details, and yield of wells Description and flow rates of springs Aquifer designation Water quality analyses	CBM drilling reports MBOGC records MBMG records DNRC Records Cadastral data Field measurements	Location map Table of source characteristics Table of water quality data
Coal Bed Hydrogeology	Hydraulic properties of CBM production zones Lithology Structural geology,	CBM drilling reports Geophysical well logs	Table of hydraulic properties Structure contour map Isopach map Geologic cross-sections
Pre-Development Ground Water Conditions	Static water levels and production of wells Spring flows	Field measurements	Potentiometric surface maps Hydrographs of spring flows and well static water levels
Production Ground Water Conditions	Production of each CBM well Static water levels in non-production CBM wells, monitor wells, and domestic/stockwater wells Shut-in water levels in key producing wells	CBM production records MBMG monitoring records	Tables of CBM production by well and coal zone Potentiometric surface maps Hydrographs of spring flows and well static water levels
Ground Water Mitigation Agreements	Number and location GPS location and elevation	MBMG records DNRC Records Cadastral data Field measurements	Table Location map Hydrographs of spring flows and well static water levels